

select the books whose titles seem promising; and eventually he must study several of these before he feels entirely satisfied. Here we find meteorology taught from the point of view of the sailor, the farmer, the physician, the merchant, the astronomer, the physicist, the forecaster, and perhaps some might even say the mathematician. The whole subject has many aspects, and each looks at it from his own point of view. Vincent's list is classified according to the languages in which the treatises are written, rather than the countries in which they are published. His list of authors, names, and dates of the various editions and translations will enable those interested in the subject to look up the books themselves in such libraries as may be at hand.

The numbers of the titles are as follows: Greek, 2 titles; Latin, 43; French, 65; German, 121; English, 42; Italian, 13; Dutch, 5; Russian, 5; Danish, 1; Spanish, 2; Hungarian, 1; Norwegian, 1; Portuguese, 1.

Many of these titles, especially those in French, German, and English, are translations of treatises already published in other languages, so that the whole number of independent works is about 200.—C. A.

#### METEOROLOGY IN EGYPT.

We learn from H. G. Lyons, Esq., Director General of the Survey Department, Cairo, Egypt, that the following changes will be made in the publication of the meteorological observations of Egypt and the Sudan, commencing January, 1906.

(1) The daily observations made at climatological stations will no longer be published monthly, but will be included in the annual report.

(2) The Monthly Weather Summary will be enlarged, and will include additional stations so as to connect the Egyptian and Sudan area with those of India and Europe, and will give a detailed summary of the climate of the month, together with the mean and extreme values of the principal meteorological phenomena.

(3) The Annual Meteorological Report will include:

- (a) An account of the climate of the year in Egypt and the Sudan.
- (b) The hourly observations made at the Helwan Observatory.
- (c) The daily observations made at the climatological stations.
- (d) The measurements of rainfall and the river gage readings of the Nile.

#### THE COLORS OF DUST-HAZE.

The German steamer *Schonfels* reports a sand storm for two days, February 16 and 17, in the Red Sea. The air was thick with a yellowish mist; every distant object had its tinge of yellow. These sand storms are the accompaniments of areas of low pressure with high winds that pass from northern Africa on to the Mediterranean, and are themselves the whirls that are formed between great areas of high pressure over Europe and the Sahara of Africa and Syria. But what we would especially call attention to is the fact that the reddish and yellowish sands, and the corresponding red and yellow hazes of the sky, differ entirely in appearance from the very white haze that accompanies the harmattan which blows from the same region southward and southwestward until it reaches the adjacent Atlantic Ocean. This northeasterly harmattan, with its white haze, occurs at the same time as the southerly sirocco with its yellowish and reddish haze, and both seem to represent the outflow from a mass of dry air, descending on the Sahara and the Sudan under the Tropic of Cancer, especially during the months of December-February. The dust of the sirocco is essentially sand, but that of the harmattan consists of the minutest shells and fragments of shells of fresh water infusoria, and microscopic algae or diatoms. The whiteness of the diatom dust, as it gathers on the decks and rigging of the vessels passing through a harmattan, like the whiteness of the harmattan haze and its hazy sky, is due not to any special color of the diatom shells, since they are composed of transparent pure quartz, but is one of the many and varied diffraction phenomena produced by the action of minute irregular objects on a beam of light. If these objects are of nearly

the same size, shape, and distance they produce a white haze, with such colored borders and spectra as we see in halo and rainbow phenomena; but if they are very irregular as to size and shape we have only the whitish haze without well-defined color bands. On the other hand the red and yellow tints of the sirocco haze seem to be due, not to any irregularity of shape or size, but to the color of the stony particles themselves as brought out by transmitted light. A very complete exposition of diffraction phenomena will be found in Chapters VII and XX of the new treatise on physical optics by Prof. R. W. Wood.—C. A.

#### CAN WE ARGUE FROM THE CLIMATE BACK TO THE OROGRAPHY?

An interesting application of our knowledge of the physics of the atmosphere is discussed by Sir Clements Markham, in the July number of the Geological Journal of London, 1905.

Explorers in the Antarctic regions have observed warm southerly winds on the mountainous eastern coast of Victoria Land. The existence of such winds arouses the question as to what they can teach us relative to the extent and shape of the Antarctic Continent. Thus far geographers have located four masses of land along the Antarctic Circle, and between them a submerged plateau, at a depth of 250 fathoms, all of which appear to form the northern coast of Victoria Land. Sir Clements's argument, to the effect that the eastern coast of Victoria Land sweeps farther south toward Graham Land, is based upon the probability that the warm southerly winds are not foehn winds, since they are reported to be damp and laden with snow, and therefore could not have just previously descended from mountains. They are oftener from the southwest than from the south. A little to the west is Mount Erebus, over which the winds come in an upper current from the west, as shown by the smoke,<sup>1</sup> and do not descend to sea level. It is, therefore, reasonable to suppose that, since they are not foehn winds, they must come from an open ocean to the south, possibly far south, beyond the South Pole, and therefore from the open Weddell Sea beyond the pole, just as warm north winds reach the east coast of Victoria Land from the open ocean to the north. It is possible, as stated by Mr. Shaw, that the snow coming with the south winds may be a surface drift, but in fact the observers on the expedition reported that heavy falls of snow from the clouds came with southerly winds, and that they were warm, not cold, winds.

We may be allowed to add that in America, when cold polar winds are followed by warm so-called equatorial winds with clouds and snow, we attribute much of the warmth to the evolution of heat that accompanies the formation of snow, and also to the protection against radiation offered by the cloudy canopy; and the presence of a sufficient quantity of vapor to form clouds and snow does not necessarily imply the presence of any large body of open water near at hand. To be sure we have heavy snowfalls along the Atlantic coast from Virginia to Maine, in which a southeast wind has brought moist air from the Atlantic only 100 miles away, but we also have heavy snows on the western slope of the Appalachians and over the Lake region, in which moist southwest winds have come, not from the Gulf of Mexico, near at hand, but demonstrably from equatorial regions, so far away that the moisture and the air must be considered as belonging to the general circulation of the atmosphere; and it would be hazardous speculation to argue from these winds and snows back to the character of the continent over which they have traveled.—C. A.

#### KRAKATOA DUST *versus* KRAKATOA VAPOR.

With reference to the origin of the so-called volcanic dust from Krakatoa, Pelée, etc., it should be remarked that it would require a systematic long-continued mechanical grinding to make an impalpable powder so uniformly fine as to be able to produce beautiful sky colors of uniform tint and wave length by diffraction. To me it seems more plausible that such fine dust, if it existed, must have resulted from the evaporation of the drops of water and condensed steam ejected by the vol-

<sup>1</sup>Is not this a banner cloud rather than smoke from Mount Erebus?—C. A.

cano. Such water must undoubtedly have been ejected hot, and must have held in solution a large percentage of the soluble solids—rock-salt, quartz, feldspar, etc. The water of these cloud particles would soon disappear in the upper air by evaporation, and their solid contents would be left floating as an impalpable powder of particles, whose size could be determined by optical methods.

On the other hand it is also important to remark that it is not unlikely that the famous red sunsets of 1883-4 were due to simple selective reflection from solid dust fragments, or to diffraction between dust particles, or to refraction and dispersion through transparent crystals. To me it seems most likely that another optical process was involved, and that these sunsets were produced essentially by a combination of two phenomena, namely (1) the selective absorption of the sunlight by the atmospheric aqueous vapor, a dense layer of which allows the red rays only to be transmitted, and (2) the diffraction of the red rays thus produced, as they passed between minute spheres of water or minute particles of dust. The diffraction effect thus produced depends on the size of these spheres or particles, and this determines the extent and duration of the sunset glow at any one place, as well as the limits of its geographical distribution. The red tint was produced by the absorptions. The particles of dust could not produce these beautiful diffraction phenomena unless they had great uniformity in their size and distribution. It is most likely that both the colored suns, the sunset sky colors, and the successive afterglows, as also the Bishop's ring of  $15^{\circ}$  to  $25^{\circ}$  radius, were due to the same minute vapor particles or so-called "vapor dust," and that mineral dust played only a minor part in their production.

Whether the particles were dust or vapor we shall obtain the same results as to their dimensions by a computation based on the diffraction formula first given by Fraunhofer, according to which particles that have an average diameter of 0.000153 Paris inch, or 0.000145 English inch, or 0.00368 millimeter, would fairly well explain the red sunset phenomena observed by me from August to November, 1885, at Washington; particles whose average diameter is 0.000101 Paris inch, or 0.000095 English inch or 0.00241 millimeter, would explain the phenomena of Bishop's ring, as observed by me on the same dates.

The fact that the red sunset phenomena continued for two years longer, my last observation being in February, 1887, and that they are frequently visible now all over the globe as a pink spot in the west after sunset, in mid-ocean as well as in the center of a continent, and that the spot never was a rare phenomenon, increases the probability that they are due to moisture rather than to mineral dust. (See *American Meteorological Journal*, April, 1889, Volume V, pages 529-544.)

An afterglow of a beautiful pink tint was frequently observed by myself in tropical regions during the cruise of the *Pensacola*, October, 1889, to May, 1890, on the United States scientific expedition to the west coast of Africa.—C. A.

#### THE CONVECTION THEORY OF WHIRLWINDS.

It is well known that Professor Espy, in developing his theory of the formation of tornadoes, and also, we believe, Doctor Mitchell of North Carolina have both of them quoted a few definite cases in which the whirl in an ascending column of flame and smoke over a fire in forest or cane brake developed into a cloud with a moving, whirling column, which, during the course of a half hour, became a rainstorm, a tornado, or thunderstorm, depending upon the condition of the surrounding atmosphere. Many others will perhaps agree with the Editor in having themselves seen a rising mass of air become at first hazy and then cloudy, and eventually turn into a rainstorm before disappearing on the horizon. The Editor has

had occasion to publish a special description of a dust whirl with a beautiful delicate central column of vapor haze, a true incipient waterspout, forming on a hot afternoon over Pennsylvania avenue in Washington, D. C., and moving along for several minutes until broken up by the mixture of currents over the house tops.

In one of the bulletins published on the U. S. S. *Pensacola* in November, 1889, during the United States Eclipse Expedition to the west coast of Africa, he published some details as to the formation, growth, and dissipation of a series of twenty or thirty waterspouts among which that vessel sailed and into some of which it penetrated.

The latest illustration of the formation of local whirls and clouds is contained in a letter from Rev. G. M. Davis, Cedar-town, Ga., dated March 15, 1905.

He stated that he "raked together a circle of dry leaves, fired them simultaneously on four sides, and noted that on two sides of the circle the fire was hotter where the pile of leaves was thicker." He then "noticed that a miniature whirlwind formed in the flame and smoke, continuing so long as the heat was greater on two sides and there was no fire in the center, while all distinguishable rotary motion ceased as soon as the heat became equable at all points." This observation suggests to him the following hypothesis with regard to hurricanes, namely, "that the interior of a circle 500 miles in diameter is filled with air of a certain temperature and surrounded by air of a higher temperature; that in this outer circle the two opposite sides are hotter than the remaining portion, and that the hot air streaming upward from these two special regions constitutes the source of the whirlwind."

This is one form of the many diversified hypotheses that have been offered, all of which taken together are known as the convectional theory. Considerable attention is given to these theories in the Editor's work known as "Preparatory Studies for Deductive Methods in Storm and Weather Predictions," Washington, 1880. Without experimenting with fire one may do even better by watching the movements of the steam and air above a horizontal surface of boiling water. (See page 29 of that work.) The rising vortex is by no means the only form of motion. However, all such theories seem not to be directly applicable to the origin of hurricanes, however well they may apply to the origin of tornadoes and thunderstorms. In the case of the hurricane we have to deal with nearly horizontal motions; the ascending component is so slight that although it exists and is important yet it can not be thought of as causing the whirlwind. In so far as hurricanes have been traced back to their origin the daily weather maps simply show a large area of perhaps 10,000 square miles within which the winds are light and variable, and the temperature and moisture a little higher than on the outside. A strong current of wind suddenly appears pouring into this region—it may be a northerly wind on the west side or a southerly wind on the east side, an easterly wind on the north side or a westerly wind on the south side—and quickly the whole mass gets into motion, and the barometer falls in the central region.

Ferrel has shown that the fall in the barometer and the rotation of the whole mass is due to the diurnal rotation of the earth on its axis. A very slight barometric depression is sufficient to start a current of air in the direction of the gradient, and this wind then causes a great barometric gradient in a direction at right angles to it; so the isobars and gradients shown on our daily weather maps around every storm center are the result of the winds and the rotation of the earth. When once the rotation is started it would die away, on account of the resistances offered by the earth's surface, unless there were some maintaining cause, and two such causes have been discussed.

First. That one suggested by Espy, and especially worked out